

Predictors of Mortality and Institutionalization after Hip Fracture: The New Haven EPESE Cohort

ABSTRACT

Objectives. Hip fractures can have devastating effects on the lives of older individuals. We determined the frequency of occurrence of hip fracture and the baseline factors predicting death and institutionalization at 6 months after hip fracture.

Methods. A representative cohort of 2812 individuals aged 65 years and older was followed prospectively for 6 years. Hip fractures were identified, and the occurrence of death and institutionalization within 6 months of the fracture was determined. Prefracture information on physical and mental function, social support, and demographic features and in-hospital data on comorbid diagnoses, fracture site, and complications were analyzed to determine predictors of death and institutionalization after hip fracture.

Results. Of 120 individuals suffering a hip fracture, 22 (18%) died within 6 months and 35 (29%) were institutionalized at 6 months. The predictors of death in multiple logistic regression included fracture site, a high number of comorbid conditions, a high number of complications, and poor baseline mental status. The primary predictor of institutionalization was poor baseline mental status.

Conclusions. The frequency of death, institutionalization, and loss of function after hip fracture should prompt a reevaluation of the current approach to this problem. (*Am J Public Health*. 1994;84:1807-1812)

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Introduction

Hip fractures occur frequently in elderly individuals and often have devastating effects on the lives of those who sustain them. Over 200 000 hip fractures occur in individuals aged 65 years and older in the United States every year at a cost of over \$7 billion.^{1,2} Older individuals and women are at greatest risk for hip fractures,^{3,4} with one study showing that by age 90, 32% of women and 17% of men will have sustained a hip fracture.⁵ Hip fractures are potentially catastrophic events with adverse outcomes including alteration in function, institutionalization, and death. This study will focus on the latter two outcomes.

The impact of a hip fracture on mortality occurs in the first 6 months after the fracture. This mortality varies from 13% to 44%.⁶⁻¹⁰ Differences in the populations studied can explain a good deal of this variance; patients who are older and have poor prefracture mental status and mobility have increased mortality. These risk factors are more prevalent in institutionalized patients; the residence of patients at time of fracture can thus have a major impact on mortality. Studies including only community-living individuals who are alert enough to participate can be expected to have lower mortality rates than those that include a substantial number of nursing home patients.

A number of recent studies have assessed the risk of long-term institutionalization for patients with hip fractures. Fitzgerald et al.,^{11,12} Gerety et al.,¹³ and Palmer et al.¹⁴ found different impacts of the Medicare prospective payment system on institutionalization, but did not assess individual patient factors. Ceder et al.¹⁵ found that living alone and delayed ambulation predicted long-term place-

ment, whereas Bonar et al.¹⁶ concluded that advanced age, disorientation, dependence in activities of daily living, and less family involvement were associated with long-term nursing home stays.

Many of these studies were limited not only by the selection of patients, but also by the difficulty of obtaining essential information such as the patient's prefracture mental status and functional abilities. The true impact of these fractures on mortality and patient placement, as well as the importance of patient factors in these outcomes, would be best determined by a population-based prospective study of hip fractures.

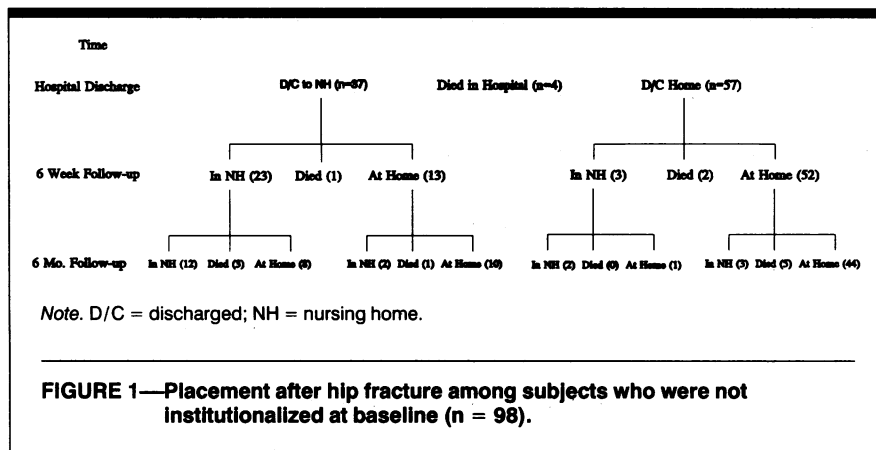
We have had the unique opportunity to follow prospectively a population of individuals aged 65 years and older as part of the New Haven Established Populations for Epidemiologic Studies of the Elderly (EPESE) project. In a substudy of this project, we identified all individuals who suffered a hip fracture from 1982 to 1988 and followed them for 6 months. We thus have information on subjects before, during, and after their hip fracture. The

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effects of hip fracture on physical function were reported previously.¹⁷

The objectives of the present study were to describe the frequency of occurrence of death and institutionalization at 6 months after hip fracture in a cohort of community-living elders followed prospectively and to determine the risk factors that predicted these adverse outcomes. As previously described, the New Haven EPESE cohort offered numerous advantages for the achievement of these objectives, including a prospective study design providing true prefracture baseline data on potential risk factors; a cohort representative of urban community-dwelling elders in this region, inclusion of all cohort members who suffered a hip fracture during the study period regardless of place of residence or prefracture functional status, and the collection of detailed clinical information on all hip fracture patients.¹⁷

Methods

Subjects

Subjects were drawn from the Yale Health and Aging Project, one of four sites funded by the National Institute on Aging as part of the EPESE program. This cohort of 2812 individuals was derived from a probability sample of noninstitutionalized men and women aged 65 years and older living in New Haven, Conn, in 1982. The probability sample was stratified by housing type with an oversampling of men. Details of the sampling design have been described previously.^{18,19} The resulting cohort consisted of 1643 women and 1169 men from diverse ethnic, racial, and social backgrounds.²⁰ For the purposes of this study, only subjects who sustained a hip fracture were included.

Study Sample/Data Collection

All EPESE respondents underwent in-home interviews every 3 years (1982, 1985, 1988) and phone interviews in intervening years. The interviews were performed by trained interviewers. During these interviews extensive information was collected on physical and mental function, chronic medical conditions, social support, and other socioeconomic and demographic features.

The two New Haven hospitals, Yale-New Haven and Saint Raphael, accounted for over 85% of all hospitalizations among EPESE participants. A nurse-interviewer monitored these hospitals weekly from the onset of the EPESE project until October 31, 1988, and all respondents with a discharge diagnosis of hip fracture were enrolled in the current study. For these subjects, clinical information on comorbid diagnoses, place of residence, hip fracture site, complications, and in-hospital death was taken directly from the medical record by the project nurse. All hip fractures were treated surgically. The project nurse then interviewed these subjects in person at 6 weeks and 6 months after the fracture to assess survival, physical function, place of residence, and other information. Thus, prefracture information was obtained by both in-person and telephone interviews, and postfracture information was obtained in person.

Measures

This extensive data collection process yielded a substantial amount of information on subjects before the fracture occurred, at the time of fracture, and 6 weeks and 6 months after the event. Baseline factors assessed prospectively before the fracture occurred included

physical function (bathe, dress, eat, groom, toilet, transfer, walk across a room, do heavy housework, walk one-half mile, climb a flight of stairs)^{21,22}; mental status (number of errors on the 10-item Pfeiffer Short Portable Mental Status Questionnaire²³; depressive symptoms (score [0–60] on the Center for Epidemiologic Studies–Depression (CES-D) scale²⁴; self-rated health; social network and support measures such as social network size, number of sources of emotional or task support, marital status, and social activities (participation in cards/games/bingo, movies/restaurants/sporting events, day or overnight trips, groups, religious services, volunteer work, paid work); and demographic features such as age, gender, education, and race. Information on demographic features came from the initial interview in 1982; information on mental status, depression, and social support came from the most recent in-home interview preceding the hip fracture; and information on physical function came from the most recent yearly interview preceding the hip fracture. The mean interval between the most recent yearly interview and the hip fracture was approximately 6 months. Factors assessed at the time of the fracture from medical chart review included the number of comorbid diagnoses (angina, arrhythmias, cancer, chronic obstructive pulmonary disease, congestive heart failure, dementia, diabetes, myocardial infarction, peripheral vascular disease, stroke); the number of complications (fever, hematoma, pneumonia, pressure sore, pulmonary embolus, thrombophlebitis, urinary tract infection, wound infection, other); fracture site; and place of residence at the time of admission.

Death was assessed in the hospital by chart review and at the 6-week and 6-month interviews by the nurse. Also, continuous monitoring of local newspaper obituaries and death certificates of all cohort members was undertaken to identify this outcome. Information on institutionalization was obtained at the same time points by determining the discharge disposition from hospital records and the place of residence at the 6-week and 6-month interviews. Subsequently, Yale Health and Aging Project records were cross-matched with the Connecticut Department of Health Services Nursing Home Registry to determine whether institutionalization took place at any time in the 6 months after the fracture.

Analysis

The frequency of occurrence of hip fracture in all cohort members was assessed. Adverse outcomes such as death and institutionalization in the 6 months after a hip fracture were assessed.

Bivariate and multivariate analyses, stratified by site of baseline residence, were performed for all subjects suffering a hip fracture to determine which baseline factors were associated with death and with continued institutionalization 6 months after hip fracture. The baseline factors evaluated in these analyses were derived from previous studies and clinical experience. These factors were assessed before or at the time of the fracture and encompassed mental function (mental status, depression), physical factors (complications, fracture site, comorbid illnesses, physical function), social networks and support (network size, marital status, emotional support, instrumental support, social activity scale), and demographic features (age, gender, race, education) as described above. The outcome measures in bivariate analysis were death and institutionalization at the 6-month interview. The association between categorical independent variables and the outcome measures was assessed by using chi-square tests (Fisher's exact test for small cell counts), whereas *t* tests were used for dimensional independent variables. Independent variables with a bivariate association of $P \leq .25$ were entered into multiple logistic regression models that used stepwise and backward elimination techniques. Factors significantly ($P < .05$) associated with the outcomes were then entered in a final multivariate model for each outcome. All analyses were conducted with SAS software.²⁵

Results

Of the 2812 cohort members, 120 sustained a hip fracture over the 6-year study period and were treated at the two New Haven hospitals (nine individuals sustaining hip fracture were treated at other institutions outside the area and were not included in the analyses). Twenty-two (18%) of these 120 died within 6 months of the fracture (5 during hospitalization, another 7 by 6 weeks). Sixty-six (55%) individuals were institutionalized at any time in the 6 months after fracture, and 35 (29%) remained institutionalized at 6 months. Of the 120 individuals, 22 were in nursing homes before the fracture occurred. Six (27%) of

TABLE 1—Factors Associated with Death within 6 Months after Hip Fracture

Risk Factor	Subjects Who Died, by Baseline Residence			
	Community		Institution	
	No.	%	No.	%
Demographic				
Age, y				
65–74	1/18	6	1/4	25
75–84	9/53	17	1/10	10
≥ 85	6/27	22	4/8	50
Gender				
Female	6/69	9**	4/17	24
Male	10/29	35	2/5	40
Race				
White	13/86	15	6/19	32
Non-White	3/11	27	0/3	0
Education, y				
≥ 9	4/44	9	2/7	29
≤ 8	10/49	20	4/11	36
Physical				
Complications				
0	3/50	6**	2/15	13*
1	3/24	13	2/4	50
≥ 2	10/24	42	2/3	67
Site of fracture				
Intertrochanteric	2/47	4**	3/12	25
Femoral neck	11/45	24	2/7	29
Subtrochanteric	3/6	50	1/3	33
Comorbid diagnoses				
0–1	6/67	9**	2/11	18
≥ 2	10/31	32	4/11	36
Prefracture function ^a (no. of items performed)				
9–10	7/50	14	1/3	33
7–8	5/34	15	3/7	43
0–6	4/14	29	2/12	17
Self-rated health				
Excellent/good	6/45	13	3/5	60
Fair/poor/bad	6/46	13	2/13	15

(Continued)

these individuals died, and the other 16 (100% of survivors) remained institutionalized at 6 months after the fracture. Of the 98 subjects living independently in the community at baseline, 16 (16%) died within 6 months of the fracture and 19 (23% of survivors) were institutionalized at 6 months.

Figure 1 illustrates the movement of previously community-dwelling patients between various sites in the 6 months after a hip fracture. Three patients discharged directly home were in nursing homes at 6 weeks, and two of these individuals were still in nursing homes at 6 months. Three additional patients who were discharged home and remained home at 6 weeks were in nursing homes at 6 months. Two patients who were dis-

charged to nursing homes from the hospital were home at 6 weeks and back in nursing homes at 6 months. Thus, within 6 months of hip fracture, the placement of patients was not static.

In bivariate analysis among individuals living in the community before the fracture, several factors were significantly associated with death (Table 1). Thirty-five percent of males died compared with 9% of females ($P = .002$). Forty-two percent of subjects with two or more postoperative complications died compared with 13% of those with one complication and 6% of those with none ($P < .001$). Thirty-two percent of those with two or more comorbid conditions died compared with 9% of those with zero or one comorbid condition ($P = .004$). Fifty percent of the

TABLE 1—Continued

Risk Factor	Subjects Who Died, by Baseline Residence			
	Community		Institution	
	No.	%	No.	%
Mental				
Mental status (no. of SPMSQ errors)				
0–3	9/77	12*	2/6	33
≥ 4	5/14	36	3/14	21
Depression (CES-D score)				
< 16	9/74	12	3/10	30
≥ 16	3/15	20	2/7	29
Social ties				
Network size				
≥ 8	4/30	13	1/6	17
5–7	5/27	19	2/6	33
0–4	4/35	11	2/5	40
Emotional support				
No need	2/17	12	2/4	50
Need, ≥ 1 source	10/61	16	2/9	22
Need, no sources	1/12	8	1/5	20
Instrumental support				
No need	0/4	0	1/4	25*
Need, ≥ 1 source	13/80	16	4/13	31
Need, no sources	0/7	0	0/1	0
Marital status				
Not married	10/77	13	6/18	33
Married	5/19	26	0/2	0
Social activities ^b (no. of items performed)				
≥ 2	8/51	16	1/6	17
0–1	8/47	17	5/16	31

Note. SPMSQ = Short Portable Mental Status Questionnaire; CES-D = Center for Epidemiologic Studies–Depression Scale.

^aItems assessed at baseline were bathing, dressing, eating, grooming, toileting, transferring, walking across a room, doing heavy housework, walking one-half mile, and climbing a flight of stairs.

^bItems assessed at baseline were cards/games/bingo, movies/restaurants/sporting events, day or overnight trips, group participation, religious services, volunteer work, and paid work.

* $P \leq .05$; ** $P \leq .01$.

small number of subjects with subtrochanteric fractures died compared with 24% of those with femoral neck fractures and 4% of those with intertrochanteric fractures ($P = .002$). Thirty-six percent of subjects with poor mental status (defined as 4 or more errors on the 10-item Short Portable Mental Status Questionnaire) died compared with 12% of those with 3 or fewer errors ($P = .04$).

In multiple logistic regression models, the factors that continued to have a statistically significant association with death among community-living individuals included fracture site, an increasing number of comorbid conditions, poor mental status, and an increasing number of complications (Table 2).

Among the 22 individuals living in nursing homes before the fracture, only an increased number of complications

was significantly associated with death in bivariate analysis ($P = .03$). Multivariate analysis could not be performed due to the small number of subjects.

In bivariate analysis among individuals living in the community before the fracture, only one factor was significantly associated with institutionalization at 6 months (Table 3). Fifty-six percent of individuals with poor baseline mental status were institutionalized at 6 months compared with 19% of those with intact mental status ($P = .03$). Several other factors exhibited a trend, but were not significantly associated with institutionalization, including poor physical function (40% of those scoring 0–6 on a 10-item scale were institutionalized compared with 21% of those scoring 7–10; $P = .22$) and being unmarried (27% of unmarried subjects were institutionalized compared

TABLE 2—Multiple Logistic Regression: Factors Associated with Death within 6 Months after Hip Fracture

Predictor	Adjusted OR	95% CI
Comorbid diagnoses (≥ 2 vs 0–1)	9.81	2.00, 48.08
Femoral neck vs intertrochanteric fracture	9.06	1.61, 51.02
Mental status (≥ 4 errors on SPMSQ vs 0–3 errors)	6.92	1.08, 44.22
Complications (increasing no.)	2.39	1.37, 4.20

Note. OR = odds ratio; CI = confidence interval; SPMSQ = Short Portable Mental Status Questionnaire.

with 7% of married subjects; $P = .17$). In multiple logistic regression models, only poor baseline mental status was significantly associated with institutionalization (≥ 4 errors vs 0–3 errors on the Short Portable Mental Status Questionnaire: odds ratio [OR] = 9.11; 95% confidence interval [CI] = 1.60, 51.79), although being unmarried was marginally associated (OR = 9.12; 95% CI = 0.84, 98.95). All individuals institutionalized at baseline who survived 6 months after the fracture remained institutionalized.

Although there was a trend toward increasing mortality and institutionalization with increasing age, this trend was not statistically significant in either bivariate or multivariate analysis, whether age was entered in the models as a categorical or continuous variable.

Discussion

Death and long-term institutionalization occurred frequently after hip fracture in this prospectively followed cohort. Overall, 57 (48%) of the 120 individuals who suffered a hip fracture either died or were institutionalized at 6 months after the fracture. The key predictors of death after hip fracture included a high number of comorbid diagnoses, fracture site, poor

mental status, and a high number of postoperative complications. Among community-living subjects, the primary predictor of institutionalization at 6 months after hip fracture was poor baseline mental status.

The study presents a unique opportunity to determine the risk of death and institutionalization among elderly patients with hip fractures. Studies that evaluate consecutive patients admitted to one institution are limited by the amount of information available in patients' charts to determine factors such as prefracture mental status and physical function.²⁶⁻²⁸ Studies that made an effort to collect this information on admission from sources in addition to the patients' charts usually limited participation to patients living in the community and/or with good mental status.^{7,29} With these concerns in mind, this study's overall mortality rate at 6 months (18%) is comparable to that of other studies that included all patients.

Poor mental status was significantly associated with death after hip fracture, confirming the results of prior studies.^{7-10,26,29,30} There was a trend toward increased mortality with decreased physical function (29% mortality if subjects were able to perform only 0-6 functions, 14% if subjects were able to perform 7-10 functions) in those living in the community before the fracture, but it did not achieve statistical significance. Interestingly, premorbid depression, presence of emotional support, participation in social activities, and self-rated health were not associated with death after hip fracture.

A high number of comorbid diagnoses^{7,9,10,27,28,30,31} and medical complications occurring after the fracture^{10,27,30} were associated with mortality, confirming prior studies. Fracture site was also associated with mortality. Few studies include or specifically comment on subtrochanteric fractures, although Beals noted high in-hospital mortality and low 5-year survival for them.³² Studies that compared mortality from intertrochanteric fractures with that from femoral neck fractures had varying results. Some early studies^{33,34} noted a high mortality rate for subjects with intertrochanteric fracture, although more recent studies did not note any difference, particularly when accounting for age.^{27,28,31,35}

We limited our analysis of 6-month institutionalization to the 98 patients who were living at home before the fracture, because all surviving patients admitted from nursing homes were in these institutions 6 months after the fracture. Figure 1

TABLE 3—Factors Associated with Institutionalization at 6 Months after Hip Fracture among Subjects Who Lived in the Community at Baseline

Risk Factor	No. (%) Institutionalized
Demographic	
Age, y	
65-74	3/17 (18)
75-84	10/44 (23)
≥ 85	6/21 (29)
Gender	
Male	3/19 (16)
Female	16/63 (25)
Race	
White	16/73 (22)
Non-White	3/8 (38)
Education, y	
≤ 8	7/39 (18)
≥ 9	11/40 (28)
Physical	
Complications	
0	10/47 (21)
1	5/21 (24)
≥ 2	4/14 (29)
Site of fracture	
Femoral neck	6/34 (18)
Intertrochanteric	12/45 (27)
Subtrochanteric	1/3 (33)
Comorbid diagnoses	
0-1	17/61 (28)
≥ 2	2/21 (10)
Prefracture function ^a (no. of items performed)	
9-10	9/43 (21)
7-8	6/29 (21)
0-6	4/10 (40)
Mental	
Mental status (no. of SPMSQ errors)	
0-3	13/68 (19)*
≥ 4	5/9 (56)
Depression (CES-D score)	
< 16	16/65 (25)
≥ 16	2/12 (17)

(Continued)

TABLE 3—Continued

Risk Factor	No. (%) Institutionalized
Social ties	
Network size	
0-4	8/31 (26)
5-7	4/22 (18)
≥ 8	6/26 (23)
Emotional support	
No need	4/15 (27)
Need, ≥ 1 source	11/51 (22)
Need, no sources	3/11 (27)
Instrumental support	
No need	0/4 (0)
Need, ≥ 1 source	15/67 (22)
Need, no sources	3/7 (43)
Marital status	
Married	1/14 (7)
Not married	18/67 (27)
Social activities ^b (no. of items performed)	
≥ 2	11/43 (26)
0-1	8/39 (21)

Note. SPMSQ = Short Portable Mental Status Questionnaire; CES-D = Center for Epidemiologic Studies-Depression Studies Scale.

^aItems assessed at baseline were bathing, dressing, eating, grooming, toileting, transferring, walking across a room, doing heavy housework, walking one-half mile, and climbing a flight of stairs.

^bItems assessed at baseline were cards/games/bingo, movies/restaurants/sporting events, day or overnight trips, group participation, religious services, volunteer work, and paid work.

* $P \leq .05$; ** $P \leq .01$.

patients with hip fractures. Bonar et al.¹⁶ noted that disorientation and lack of family involvement contributed to institutionalization at 6 months. Ceder et al.¹⁵ and Fitzgerald et al.^{11,12} noted that lack of social support at baseline was an important predictor of institutionalization. Our results showing that good prefracture mental status and being married were protective against institutionalization are consistent with these prior studies. We found no association between institutionalization and premorbid depression, participation in social activities, or social factors such as network size and emotional support. Our psychosocial data were assessed before the fracture and are thus unlikely to have been influenced or biased by the occurrence of the hip fracture. It is possible that in earlier cross-sectional or retrospective studies either the psychosocial conditions were influenced by the severity of the disease,

illustrates the dynamic state of patients after discharge from hospital. There was a good deal of flow of patients from nursing home to home, and a smaller number of the patients went from home to nursing home in the 6 months after fracture.

Relatively few studies have evaluated the predictors of institutionalization in

or postfracture status was critical to prognosis. Further studies will be needed to clarify this point. There was a trend toward increased institutionalization in those patients with poor prefracture physical function, but it did not achieve statistical significance. These results confirm the beliefs of many clinicians that patients who have limited function before fracture, who have altered mental status, and who live alone are at high risk for long-term institutionalization.

The risk factors for death and institutionalization at 6 months noted here and in previous studies need to be taken into account as we evaluate patients with hip fractures. The high mortality associated with altered mental status and poor general medical condition and the substantial impact that altered mental status has on long-term institutionalization should be emphasized both in the treatment and discharge planning of patients. □

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